UNIVERSITY OF CAPE TOWN

The Effect of Paternal Education on Child Health in South Africa: A Longitudinal Analysis

by

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Abstract

This paper seeks to explore the relationship between the education of fathers and child health in South Africa. A key aspect of this paper is whether or not fathers are present in the household. We believe paternal absence may attenuate the effect that paternal education has on child health. This study uses the first four waves of the National Income Dynamics Study (NIDS) in order to conduct a longitudinal analysis. This dissertation uses random-effects regression to study the effect of paternal education and presence on height-for-age z-score (HAZ), weight-for-age z-score (WAZ) and perceived health status (PHS) of children aged 0 to 15. The results of this dissertation suggest a significant positive association between paternal secondary and tertiary education and child height-for-age and weight-for-age. Paternal absence is also a significant determinant of these anthropometric outcomes, implying that paternal education may still have a positive effect on child health even if fathers are absent from the household. We find no evidence of a relationship between paternal education and PHS.

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Abbreviations

BMI	Body Mass Index
FE	Fixed-Effects
HAZ	Height-for-age Z-score
IV	Instrumental Variable
MDG	Millennium Development Goal
NIDS	National Income Dynamics Study
OLS	Ordinary Least Squares
PHS	Perceived Health Status
PID	Person Identification
RE	Random-Effects
SA	South Africa
SDG	Sustainable Development Goal
SES	Socioeconomic Status
SSA	Sub-Saharan Africa
WAZ	Weight-for-age Z-score

Symbols

1q0	Probability of an average person aged exactly 0 dying within 1 year
5q0	Probability of an average person aged exactly 0 dying within 5 years
e	Euler’s Constant

Chapter 1

Introduction

1.1 Background

At a summit in 2000, the United Nations (UN) set out its list of eight Millennium Development Goals (MDGs) - a list of time-bound targets addressing the major issues impacting the developing world. These goals included improving access to education (MDG2), promoting gender equality (MDG3), improving maternal healthcare (MDG5) and reducing child mortality (MDG4), to name a few. It is thus by no coincidence that the impact of maternal education on child mortality has become a popular topic amongst researchers (Jones et al., 2003). Studies have also extended beyond child mortality, looking at ways of improving other indicators of child health and nutrition. Maternal education has, however, been an area of interest long before the inception of the Millennium Development Goals. Many researchers have drawn inspiration from the work of Caldwell (1979) in Nigeria, where the author examined education as a determinant of mortality decline. This paper highlighted education, not only as a driver of the demographic transition, but of the health transition as well. Using the framework constructed by Mosley and Chen (1984), many authors have since built on the research in this field, highlighting the mechanisms and pathways through which education of mothers may impact the wellbeing of children in the developing world.

The focus on mothers can be attributed to numerous factors. Firstly, mothers are often the primary caregivers of children in developing countries. They are responsible for making decisions regarding the hygiene, nutrition and general wellbeing of children (Sossa et al., 2017, Fuchs et al., 2010). It is thus highly plausible that mothers, and their characteristics, affect children to a greater extent than fathers. Another reason behind the focus on mothers is that researchers believe there is less bias in the survey data, as information on partners is often reported by their wives (Chen and Li, 2009). Previous research has also found weak associations between fathers and the health of their children (Akter et al., 2015).

Many researchers have often regarded education as a component of socioeconomic status (SES), and have thus neglected to separate the two when addressing child health. Fuchs et al. (2010) believe that disentangling education from SES may lead to stronger results, and thus more targeted polices. Some studies have also looked at other facets of SES, such as household wealth and occupation, in order to investigate how these variables affect child health. Certain studies have compared the effects of wealth versus education as determinants of child health (Macassa et al., 2003, Wamani et al., 2004, Boyle et al., 2006, Fuchs et al., 2010). The majority of these studies have concluded that while wealth and occupation did impact positively on child health, parental education served as the greatest influencing factor.

Drawing on SES has led to the introduction of fathers as research subjects, especially in the developing world, where traditional gender norms prevail. While mothers are seen as nurturers, fathers often take on the role of “breadwinner”, and are thus assumed to be a more appropriate subject when addressing socioeconomic status (Ditekemena et al., 2012). As the primary income generators in most sub-Saharan African households, men often carry the duty of providing financial security for their families (Madhavan et al., 2008). Fathers thus have a large bearing on the SES and living conditions of their families. Besides generating income, fathers are often more educated than mothers in developing countries, therefore it may be more appropriate to study their education, rather than that of mothers (Aslam and Kingdon, 2012, Semba et al., 2008).

While strides have been made to include fathers in studies, there are a few reasons as to why researchers remain reluctant to study fathers in isolation. Firstly, as mentioned before, studies have found weak associations between fathers and child health. However, Sossa et al. (2017) claim that the impact of paternal education on child health could have occurred due to omitted factors. The authors assert that unobservable variables could have caused bias in this relationship. In South Africa particularly, there is a high incidence of fathers abandoning their families, attenuating any possible effect they may have on their children’s lives (Madhavan et al., 2008). As a result, a large proportion of households in South Africa are headed by females (Schatz et al., 2011). Researchers also neglect fathers due to traditional gender roles: fathers often avoid engaging with their children, especially in a sub-Saharan African setting (Richter et al., 2010). Another possible reason for the relative lack of interest in fathers is that fathers have largely been neglected in the UN’s new Sustainable Development Goals (SDGs) (Sachs, 2012).

This study attempts to fill this gap by:

i. Exploring the effect of paternal education on child health, by isolating the income generating role of fathers from their education
ii. Examining how this effect varies by presence of fathers in the household

The significance of this dissertation is that very few studies, if any, have researched the impact of paternal education on child health in South Africa. There is a need to understand the pathways through which paternal education impacts the health of children. The separation of paternal education and income improves the likelihood of generating more targeted interventions, thereby contributing towards the SDGs as laid out by the UN. By analysing the two variables independently from one another, we will be able to understand the magnitude to which each affects child health and will thus be able to generate an appropriate response accordingly. Thus, this research has the potential to spur governments of developing countries into creating policies that address the education of boys and young men in an attempt to improve the health of children.

1.2 Organisation of this Dissertation

This dissertation comprises of five chapters. After this chapter, Chapter 2 presents a review of the most relevant literature on the effect of paternal education on child health. Chapter 3 elaborates on the data sources and methodology used for this dissertation. Chapter 4 presents the results of this study. Lastly, Chapter 5 highlights the most important aspects of this dissertation and expands on the scope for further research.

Chapter 2

Review of Literature

The purpose of this chapter is to critically assess and review prior literature surrounding the topic of paternal education and its effect on child health. Section 2.1 looks at the seminal papers in this field of research. Section 2.2 highlights papers focusing on the education of fathers as a determining factor of child health. Section 2.3 explores the literature beyond the education of fathers. Lastly, Section 2.4 highlights papers that have explored the mechanisms through which parental education affects child health.

2.1 Seminal Work on the Effect of Education on Child Health

In trying to reduce child mortality in developing countries, researchers identified education as one of the key socioeconomic drivers responsible for addressing child health. It was widely believed that a greater parental educational attainment, specifically of mothers, will positively affect the health of children and subsequently reduce child mortality levels. Perhaps the seminal paper in this field of research was that of Caldwell (1979). In a study focusing on Nigeria, the author identified education as a key factor in mortality decline. The author noted that education had been a key driver, not only in the demographic transition of Nigeria, but also in the health transition. The paper aimed to link mortality and fertility declines to the same underlying social factor: education. Caldwell asserted that educated mothers are able to improve the nutritional intake of their children, without imposing significant costs on the household. Furthermore, the author believed that educated mothers were better understood by medical practitioners, thus increasing the probability of survival for their children.

However, it is Mosley and Chen (1984) who presented an elegant analytical framework for studying child survival in developing countries. While this paper's key focus was not necessarily education, it did propose a solution for capturing all relevant sociological and medical approaches to research on child survival. This framework provided sociologists and demographers with a new way of looking at child survival determinants. This framework captured important elements pertaining to child survival, such as maternal factors, environmental factors, nutrition, injury and personal illness control. These factors directly influenced the risk of morbidity and mortality in children. Agha (2000) adopted Mosley and Chen's framework in analysing the determinants of infant mortality in Pakistan. The author described the proximate determinants as the underlying mechanisms through which socio-economic processes affect child health. In a study focusing on child mortality in rural India, Das Gupta (1990) believed that Mosley and Chen's framework strengthened the assumption that variation in mortality within a given community could be explained by socio-economic differentials, such as education and income. Mosely and Chen's association between maternal skills and education may have also been the reason behind the lack of interest in analysing the education of fathers, throughout the literature.

Another important component of education is literacy. In a synthesis of all relevant literature surrounding the topic, Grosse and Auffrey (1989) noted the strong and consistent association between literacy and mortality. The authors explained that health and literacy experience a circular causation, whereby literacy affects health, and, in return, health affects educational attainment. The order of causation is unknown. The authors referred to the suggestion of Caldwell (1979), where the author claimed that literacy led towards the adoption of modern attitudes, which subsequently increased people's acceptance of and reliance on modern healthcare practices.

2.2 Effect of Fathers on Child Health and Mortality

Research on the effects of fathers on the health of their children in developing countries is scarce (Adjiwanou et al., 2018). However, the focus on fathers in the developing world is gaining traction due to an increased scrutiny of gender roles as well as the protracted examination of maternal education. Sossa et al. (2017) stated that variables related to family background, that are unobserved, may cause bias in the relationship between paternal education and child health. In this paper, the authors examined the association between paternal education and child mortality in Benin. The authors argued that the contribution of fathers towards child health could not be detached from their role as income generators. The authors stated that omitted variables can cause bias in the relationship between parental education and child health because these missing variables often correlate with both child health and education. The relationship between parental education and child health usually weakens once family background is controlled for. Another issue the authors raised is that educated women are more likely to marry educated men. Therefore, the differential impact of paternal and maternal education on child health or child survival may be biased, unless the unobserved characteristics are controlled for. One limitation of this study is that the data used were cross-sectional, limiting causal inference.

Few studies have focused on the topic of fatherhood and child health in a South African context, especially with regards to education. The bulk of the literature on South African fathers has been on the effect of paternal presence in the household on child psychology. Children's nutrition and healthcare are more likely to be supported and encouraged when fathers are present (Sherr et al., 2014). There are also numerous psychological benefits for children whose fathers are present in the household. Richter et al. (2010) assessed the psychological and emotional benefits of paternal presence in South Africa. The authors stated that South Africa had the lowest marriage rate on the continent, which they believed severed the relationships between many children and their fathers. South Africa also has the second highest rate of paternal absence in Africa. From the literature, it is evident that the effect of paternal education on child health was mainly due to the income-effect – fathers are the income generators of households, and this income contributes to improving the health of their children (Madhavan et al., 2014). The fact that traditional gender-roles still prevail in developing countries compounds the fact that fathers are responsible for income generation, while mothers have a duty to look after the health of their children. Ball et al. (2007) argued that some of the most important ways that fathers may contribute to child health work through the environment in which the child grows and develops. The authors stated that fathers' contributions to child health may be under-estimated since the effects are indirect, and thus more difficult to measure.

Male partners' education can affect child health indirectly through the links of maternal and women's reproductive health in developing countries. Adjiwanou et al. (2018) assessed how claimed that the focus on male partners' education has been largely neglected in developing countries. In around 10% of the sample there was significant misreporting in women's reporting of partner's education. The authors claimed that gender power inequities may weaken the maternal impact on children's health, making women more reliant on the decisions of an educated partner. More educated (and thus wealthier) males also have greater social capital, affording women and children access to higher quality healthcare services. This study found that women whose partners have secondary (or more) education are 54% more likely to use skilled birth attendance compared to women whose partners have any formal education. Partners' education was also found to be less relevant for maternal and reproductive health at a primary level. Mechanisms underlying male education may be amplified, thus increasing partners' effects on women's health behaviour and child well-being. This is due to the phenomenon of gender power inequities, which give disproportionate power to men, especially in developing countries. Paternal gender roles may also prevent women from realising their agency to address their health needs. This paper concluded that paternal education was a determining factor of reproductive health, although it was not as powerful as maternal education.

Although Sossa et al. (2017) and Adjiwanou et al. (2018) focussed strongly on paternal education in a sub-Saharan African context, earlier studies looking at the effect of paternal education on child health had been conducted outside of sub-Saharan Africa. Flores et al. (1999) was one of the first papers to investigate the education of both parents, and its association with child health. Along with parental education, the authors investigated the impact of ethnicity and income on children's health in the United States of America (USA). The authors found an inverse association between sub-optimal health status and the level of parental education. They did not, however, distinguish between the effects of mothers and fathers. Subsequently, researchers have studied the effects of parents' education on child health by separating the effects of mothers and fathers. One such study was Abuqamar et al. (2011) – a paper analysing the impact of parental education on infant mortality in Palestine. This study found the education of fathers to be a significant determinant of infant mortality.

Two common measures of child health found throughout the literature are height-for-age z-score (HAZ) and weight-for-age z-score (WAZ) (Chen and Li, 2009, Aslam and Kingdon, 2012, Güneş, 2015, Semba et al., 2008, Wamani et al., 2004). These standardised measures provide useful information on child health, and allow us to compare health between children of different ages and sexes. (Chen and Li, 2009). Height-for-age is both a measure of short- and long-run health status (Thomas et al., 1991) whereas weight-for-age, a less common health measurement, is used as an indicator of current malnutrition status (Güneş, 2015). Stunting (low height-for-age) results from prolonged periods of caloric and nutritional deficiency (Fotso, 2006). Stunting is also associated with poor cognitive development in children (Crookston et al., 2011). Wasting (low weight-for-age) of children has also been associated with poor cognitive development, and even increased risk of mortality (Kar et al., 2008, Black et al., 2008).

Aslam and Kingdon (2012) studied the pathways through which parental education affects the health of children aged 0 to 5, in Pakistan. This paper used HAZ and WAZ as proxy indicators of child health. The authors claimed that while a major body of research confirmed the more prominent effect of maternal education on child health (compared to paternal education), some recent studies have found otherwise. Aslam and Kingdon cite Chen and Li (2009), referring to the assertion that paternal education may be important as fathers are often more educated than mothers in developing countries. Aslam and Kingdon stated that fathers in Pakistan were found to have, on average, three more years of education than mothers. The authors also claimed that paternal education may be an important determinant of child health because of the low social status held by mothers in developing countries. The reduced empowerment of mothers may potentially limit the influence mothers have on decisions regarding children's health. The study found that paternal education was positively associated with health-seeking behaviour (child immunization status), whereas maternal education was associated with child health outcomes such as child height and weight.

The education of fathers has also been linked with reduced child mortality. Akter et al. (2015) studied the association between parental education and child mortality in rural Bangladesh. This study was unique in that it investigated whether the association between parental education and under-five mortality had changed from one period (1995-2000) to another period (2002-2007). The authors found that maternal education had a strong and significant association with under-five mortality for both time-periods studied and father's education had a minimal-to-moderate association with under-five mortality over both periods. The authors acknowledged that while paternal education may not have a causal effect on child mortality, fathers may indirectly contribute to lowering under-five mortality through their impact on the socioeconomic status of the household. This paper suffered from data omission, as mothers who were divorced or widowed were excluded from this analysis. There was a concern about temporality of this cross-sectional study, as one cannot be certain that education will always precede childbirth. Another limitation was that housing characteristics did not accurately represent the socioeconomic status of households.

To avoid the problem of endogeneity, some researchers have taken advantage of natural experiments to assess the effect of education on child health and schooling outcomes. Over the last century, schooling reforms throughout the world have allowed researchers to analyse the changing effect of education on health. More specifically, researchers can study how school policies have shaped the health of children before and after the implementation of these programmes. Lindeboom et al. (2009) made use of a 1947 schooling reform in the United Kingdom. The authors assessed the causal effect of parental education on several health variables. These includes variables measured from birth to later in childhood, which was necessary because effects found at birth may not necessarily last throughout a child's life. The authors found that the schooling reform only affected the educational decisions of individuals who had low education. Father's education was found to be associated with a lower body mass index (BMI) and a lower probability of being overweight. While these findings were informative, they should be approached with caution, since healthcare has improved markedly since the 1940s.

Some papers have used schooling programmes as natural experiments to understand the effect of increased schooling on child health. Chou et al. (2010) looked at a Taiwanese extension of compulsory schooling in the late 1960s. This programme extended compulsory schooling from six to nine years and led to the construction of 150 new junior high schools. The authors estimated the causal effects of mothers' and fathers' schooling on infant birth outcomes from 1978 through to 1999. The authors also proposed techniques for correcting endogeneity biases, a problem that has pervaded most of the literature. The paper's results suggest that parents' schooling causes favourable health outcomes in children. The increase in schooling was found to lower the probability of an infant being born underweight or dying in the neonatal and postnatal periods. While the authors studied the effects of mothers and fathers separately, they could not state with certainty that mother's schooling was a more important determinant of infant health than father's schooling. Breierova and Duflo (2004) took advantage of a school construction programme in Indonesia which occurred from 1973 to 1978. Instrumental variables were used to compare the causal effects of maternal and paternal education on child mortality, before and after the school construction programme took place. The authors also looked at the difference in duration between fathers' and mothers' education, and how this difference affected fertility and child mortality. The paper's findings suggested that parental education has a strong causal effect on the reduction of child mortality in Indonesia. It was found that female education did matter more than male education in determining age at marriage and number of children born. However, the results did not allow the authors to conclude that mothers' education had a stronger causal impact on child mortality than fathers' education.

A common theme running throughout the literature has been the comparison between wealth and education as child health determinants. Researchers are interested in studying which of the two variables has a greater impact on the wellbeing of children. Macassa et al. (2003) studied inequality in child mortality differentials by parental socio-economic position, in Mozambique. Socio-economic position of parents was determined by education and occupation. The authors believed that few studies have investigated this relationship in developing countries because of the difficulty in measuring socioeconomic position in developing countries, compared to Western countries. The authors found that paternal education was statistically associated with postneonatal and child mortality, whereas maternal education was associated with neither, after controlling for demographic variables and place of mother's residence. The study also found an association between parental occupation as a measure of socioeconomic position, and child mortality. Wamani et al. (2004) examined the association of four socioeconomic indicators with child health. These indicators were maternal education, paternal education, household asset index and land ownership. Growth stunting served as a proxy for health and nutrition inequalities among infants and young children. This study found that mother's education, and not father's education, was the best predictor of health inequalities, while land ownership provided no association with child health. Household assets were associated with stunting at a 1% level for only the poorest quintile.

In South Africa, the main concern about fathers is their presence in the household. Madhavan et al. (2008) examined father-child connections in rural South Africa. The authors asserted that researchers are often dissuaded from addressing fathers in South Africa because of the high proportion of fathers abandoning their families. Furthermore, it is a common belief amongst researchers that fathers who do not live with their children do not support them. This belief compounds the underestimation of paternal financial contributions towards children. However, in a study focusing on young, absent fathers in Cape Town, Clark et al. (2015) refuted this notion. This paper found that although 26% of young fathers (aged 24 or less) lived with their children, 66% of non-residential fathers maintained regular contact, and 61% provided financial support to their children. While absent fathers may play a role in the lives of their children, the importance of paternal presence should not be understated. Clark and Hamplová

(2013) found evidence from six countries that children born to never-married single mothers were significantly more likely to die before age 5, with odd ratios ranging from 1.36 in Nigeria to 2.61 in Zimbabwe.

2.3 Beyond the Effect of Fathers

Prior to research on fathers, the bulk of the literature surrounding the effect of education and child health was focused on mothers. Thomas et al. (1991) aimed to identify the mechanisms through which maternal education impacts child height in Brazil. The authors claimed that anthropometric measurements, such as height, conveyed important information about the standards of living in a society, and the health of a population. It was found that the positive impact of maternal education on child health (height) can be explained by the indicators of a mother’s access to information, such as newspapers, television and the radio. Gakidou et al. (2010) conducted a study on increased maternal educational attainment and its effect on child mortality, in 175 countries. This paper speculated that, over the last 40 years, the aversion of 4.2 million child deaths could be attributed to the increase in female educational attainment.

Chen and Li (2009) studied the effect of maternal education and child health by using a sample of adopted children in China, thereby eliminating any genetic (nature effect) explanation for child health, leaving only the mother’s care (nurture effect) as the main explanatory factor for the wellbeing of her children. The authors found that mother’s education is an important determinant of child health. The study noted that there are two major limitations. Firstly, adoptive mothers may have different qualities to biological mothers, and may treat adopted children differently than the children they have given birth to. Secondly, the “nature effect” may not be completely eliminated, since mothers may have selected healthier children to adopt.

As mentioned in the previous chapter, schooling reforms provide natural experiments for researchers to gauge how increased education may impact child health. For instance, Güneş (2015) looked the effect of a Turkish schooling law on child health. This law increased compulsory primary schooling from five years to eight years. This paper found that the change in the duration of female primary education improved both infant and child health. Grépin and Bharadwaj (2015) set out to identify the causal influence of maternal education on child mortality in Zimbabwe, where the government had extensively expanded access to secondary schools in 1980. The authors found that children whose mothers had benefited from extended education policies were 21% less likely to die than children born to slightly older mothers.

Certain studies have refuted the tendency of researchers to regard both education and household wealth as interchangeable indicators of socioeconomic status. It is believed that separating the two factors, when addressing child mortality, would help create more appropriate and targeted policies. Fuchs et al. (2010) investigated the possible causal association between maternal education and child health. While infant death was found to decline with an increase in both educational attainment and household wealth, mothers' education showed a larger and more consistent tendency to reduce the likelihood of infant death. Harttgen and Misselhorn (2006) investigated the effects of individual, household and cluster socioeconomic characteristics on child mortality and undernutrition in SSA and South Asia. While the proportion of malnutrition is higher in SSA than in South Asia, anthropometric outcomes were considerably better in SSA. This paper found that individual characteristics such as wealth, education and nutritional characteristics of mothers played a larger role in anthropometric shortfalls.

It has been hypothesised that parental education affects child health through the mechanism of health service utilisation. Ensor and Cooper (2004) claimed that there was substantial evidence to suggest that health service utilization improves child health. Education is seen as a determinant of health care utilization. Better basic education can increase the desired use of healthcare services, through improved literacy and health studies. The ability to assimilate health messages is also likely to be influenced by the level of general education. The use of skilled attendance during childbirth also decreases maternal and neonatal mortality. It has been found that education of mothers positively impacts the decision to give birth with the help of skilled medical personnel, thereby reducing the risk of neonatal mortality (Gabrysch and Campbell, 2009). In a study on pregnant women in Thailand, Raghupathy (1996) analysed the impact of female education on maternal and child healthcare service utilisation. After controlling for other determinants, the author concluded that maternal education exerted substantial influence on maternal and child health service utilisation in Thailand. Another important component of child healthcare is immunization. Vikram et al. (2012) studied the linkage between maternal education and childhood immunization in India. It was found that children of well-educated mothers were more fully immunized. This was due, in part, to the fact that these children lived in more affluent areas, with better access to healthcare facilities.

It was believed that schooling enables girls to develop skills that allow them to interact successfully with healthcare institutions when they are older.

2.4 Mechanisms Through Which Parental Education Affects Child Health

An important question posed in this dissertation is: how does the education of fathers affect child health? We do not assume a direct relationship between paternal education and child health. Many papers surrounding the topic of child health have taken a deterministic approach. For instance, Gabrysch and Campbell (2009) reviewed the determinants of delivery service use. This paper presented hypothesised mechanisms of action for each determinant. The authors stated that it is important to consider many influential factors in an analysis of delivery service use in order to form a complete picture.

Vikram et al. (2012) studied the linkage between maternal education and childhood immunisation in India. The authors understood that while access to medical care is a primary pathway of maternal education leading to improved child health, the pathways through which education improves maternal use of medical care remain unclear. The pathways highlighted in this paper were: human capital, social capital, cultural capital and empowerment. Variables relating to these four categories were then regressed against immunisation. Addressing these pathways separately helped to dissect maternal education and allows us to understand which aspects of maternal education lead to better immunisation practice.

Glewwe (1999) set out three possible pathways through which maternal education impacts child health. These mechanisms included direct learning of health information, literacy and numeracy learned from school and lastly, exposure to modern society from formal schooling, which was postulated to make women more receptive to modern medicine. From this empirical work, the author was able to conclude that schooling contributes to health knowledge only indirectly – using literacy and numeracy skills learned in school.

One of the more documented topics found throughout the literature is parental income’s effect on child health – especially that of fathers. Increased paternal income has been shown to contribute to higher levels of child health (Engle, 1993, Bornstein and Bradley, 2014). Conversely, in the literature we find that increased poverty levels are associated with higher rates of poor child health, from both a physical and cognitive level. Research has also shown that parental socioeconomic status has a strong, positive association with child health, with income serving as a large component of socioeconomic status. Parental education has been shown to be the single best predictor of parental income (Wood, 2003). Since fathers tend to be the primary income generators in sub-Saharan Africa, perhaps greater analysis of their education may be necessary, in order to better understand the mechanisms through which fathers affect the health of their children (Madhavan et al., 2008).

Before exploring the mechanisms through which education impacts child health, we need to dissect education, and investigate exactly which components of education help bring about any effect on child health. From Le Vine et al. (1994) one can distinguish four main skills that are acquired through primary schooling.

1. Health Skills

In school, children are taught basic health skills. The students then use this accumulated knowledge to look after their own children, once they become parents. Abuqamar et al. (2011) stated that parental education may impact child health through the acquisition of health knowledge. In Thomas et al. (1991), anthropometric outcomes (such as height) were modelled as a function of nutrition, breastfeeding, water and sanitation and the use of healthcare facilities, to name a few. Much of this health information is absorbed during one's schooling years. Aslam and Kingdon (2012) dedicated an entire paper to understanding the pathways of impact between parental education and child health in Pakistan. Maternal health knowledge was found to be a key pathway of influence for child height.

2. Life Skills

Glewwe (1999) illustrated the pathways of influence that parental schooling may take on its course to affecting child height, a proxy for child health. Schooling was believed to impact values. Such values include timing of marriage, age of conception and placing an importance on children. Schooling also led to female empowerment and autonomy (Fuchs et al., 2010). As a result, men become more understanding towards the rights and preferences of women. During school, children are educated on contraception. Parental education may impact child health through the pathway of family size preference (Abuqamar et al., 2011). It is through these skills that adults are able to make more informed choices regarding their children, which in turn, positively affects child health.

3. Literacy Skills

Schooling develops a child's literacy skills. These skills are used to obtain a qualification, which is then used to gain employment. Child health then benefits from the income gained from parental employment. However, Glewwe (1999) also suggested that literacy allows mothers to read instructions of medication. Literacy skills gained at school could help improve childcare practices by enabling parents to read instructions from books or medical pamphlets found in clinics. As we are entering the digital age, literacy skills help mothers use the internet to research further childcare practices. Vikram et al. (2012) stated that literacy may also help women become more receptive to health messages.

4. Numeracy Skills

School is also imperative for cognitive development. Glewwe (1999) found that schooling was seen to improve parental cognitive ability, which in turn led to obtaining a job, and subsequently generating household income. All of these variables influence household health and nutritional inputs, which in turn impact child health. According to Glewwe, numeracy skills allow mothers to better monitor the medical treatment of their children.

The education of fathers and mothers affects child health through various mechanisms (Vikram et al., 2012, Gabrysch and Campbell, 2009). These mechanisms do not work in isolation, and often combine with one another in order to bring about an effect. The skills that are acquired at school must work through different mechanisms in order to bring about an effect on child health. We highlight four major mechanisms.

1. Wealth, Income and Employment

Apart from education, we believe that income and employment are two staunch determinants of child health. These factors usually stem from fathers in an African setting, as African men are predominantly the breadwinners in their families. The wealth generated from this income then contributes to better quality food and access to cleaner drinking water. Aslam and Kingdon (2012) found that parental labour practices were found to be a key pathway of influence for child height. Another factor to take into consideration could be that women with higher education tend to have higher income and thus tend to marry men with higher income. As a result, these couples live in wealthier communities, with better access to healthcare facilities. This allows these parents to provide their children with better healthcare.

2. Prevention and Treatment Knowledge

Schooling also educates children on preventative health measures. Education helps shape modern attitudes and behaviours surrounding healthcare. Men and women in a rural setting better understand the utility of modern medical practices and facilities. The knowledge gained through health education allows parents to prevent illness in their children, and also equips them with the nous to seek medical advice if the problem is beyond their control. Another pathway highlighted in Abuqamar et al. (2011) attributed the use of healthcare facilities as another pathway through which education of fathers can affect the health of children. Thomas et al. (1991) also modelled child health as a function of the use of healthcare facilities.

3. Nutrition

Another input in the model presented by Thomas et al. (1991) was nutrition. Education helps to inform children of the importance of adequate nutritional input. Children are also educated on the benefits of breastfeeding. When these children become adults, they will use this nutrition knowledge to ensure that their own children are fed a healthy diet, further improving child health. This ensures that the children of educated parents maintain a balanced diet, thereby maintaining good health levels.

4. Hygiene and sanitation

Fuchs et al. (2010) presented a review of the literature surrounding the topic of causal mechanisms through which maternal education impacts child health. It was found that maternal education compensated for poverty in rural India, as mothers were educated on the importance of clean water and the treatment of disease. Thomas et al. (1991) included water and sanitation as determinants of child health. Learning skills such as hygienic practices in school could benefit the offspring of these learners in the future.

Table 2.1 summarizes the mechanisms affecting child health found in this chapter. The table then describes the pathways leading from parental education to child health. Lastly, this table explains the differential effect of the education of men and women on children.

Table 2. 1: Mechanisms through which Parental Education Affects Child Health

Num	Skills	Mechanisms	Combined Effects	Description	Comparison between men and women's education	Effect on children's health
1	Health skills	Prevention and Treatment	Usage of healthcare facilities and services	People become more open to using modern forms of healthcare over traditional methods.	Men and women are taught about the utility of modern healthcare. Women are educated on importance of prenatal and antenatal care. Women are also educated on the importance of breastfeeding.	Children recover from illnesses due to openness of parents to use modern medical practices and facilities
2	Health skills	Hygiene and Sanitation Prevention and Treatment	Prevention of disease	Learners are educated on various methods of preventing infection in the home.	Men who provide for their families understand how their housing affects health of the family. Ensures money is spent on storing food safely, and on proper water. Women keep the home clean and sanitary. Both men and women understand the importance of vaccinations.	Children are fed safe food and drink potable water. Children live in a hygienic environment and are less prone to disease and infection. Children are vaccinated from a young age, reducing risk of infection.
3	Health skills Life skills	Hygiene and Sanitation	Exposure to modern attitudes and behaviour	At school, children are exposed to modern ways of thinking. Adolescents are informed about contraception. Students are informed about gender equality.	Men understand the importance of contraception. Men are also more open-minded and understand gender equality. Women are empowered by the knowledge they gain from school. They are more confident and autonomous, allowing them to plan how many children they would like to have.	Children with fewer siblings could possibly receive more care and attention from parents, leading to improved physical and psychological health.
4	Literacy skills Health skills	Nutrition	Proper nutritional intake	Reading abilities allow students to discern between which foods are good and bad.	Men will know what food to buy for their families, women will know what to buy and cook for their families.	Children are fed a better, more nutritious diet, which will have positive benefits on their health.
5	Literacy skills Health skills	Prevention and Treatment	Curative measures	Ability to understand health information read and assimilate medical instructions. Treatment of diarrhoea and other diseases.	Men and women will know how to cure sick children and understand if expert medical advice is necessary.	Children's health has a greater chance of improving compared to children with less educated parents.
6	Literacy skills	Prevention and Treatment	Health information from media and social networks	Students develop the skills to comprehend health information from books, the internet and television.	Women will be able to read and understand maternal healthcare information. Male decision makers will better understand how to communicate with medical professionals.	Children are healthy as their parents are up to date on medical and health information.
7	Literacy skills Numeracy skills	Wealth, income and employment	Income generation from work	Men and women use cognitive skills learned from school in order to gain employment. Money earned from employment is used to provide for family.	Both men and women will be able to generate income for the household.	Children with wealthier parents will live in more developed areas with greater access to healthcare facilities.
8	Literacy skills Numeracy skills	Wealth, income and employment	Partner selection	Educated people tend to find partners of equal education level, giving them a greater chance of obtaining a higher standard of living.	Since men tend to be breadwinners, women will select partners of equal or higher education. Men are decision makers, understand importance vaccinations and immunizations.	Better living conditions for child in terms of safety, hygiene, sanitation. Better access to health care facilities

Chapter 3

Data and Methodology

This chapter consists of three parts. Section 3.1 examines the data sources. Section 3.2 describes the variables of interest. Section 3.3 explains the methodology and estimation procedures used in this dissertation. Lastly, Section 3.4 provides the theoretical framework underpinning this research.

3.1 Data Sources

The data used for this dissertation are drawn from the National Income Dynamics Study (NIDS) – the first panel study conducted in South Africa. The data collected is secondary in nature and currently comprises of four waves of data collection: 2008, 2010-11, 2012 and 2014-15. The Southern Africa Labour and Development Research Unit (SALDRU), based at the School of Economics at the University of Cape Town (UCT), conducted the surveys. This study was undertaken in order for the government to better understand the changing social and economic dynamics of South Africa (Leibbrandt et al., 2009).

Wave 1 was conducted using a stratified, two-stage cluster sampling design. The survey was conducted in all nine South African provinces and was targeted mainly towards private households. Data were collected from 7305 households, including information on 31170 individuals (Leibbrandt et al., 2009). The sample is not representative at a provincial level, thus inference from the study should only be made at a national level. To account for non-response and non-inclusion of primary sampling units, design weights were calculated. Furthermore, post-stratification weights were required to ensure that the NIDS sample's age, sex and race distributions were in line with the distributions calculated by Stats SA in 2008. Due to the fact that NIDS is a panel study, subsequent waves of this study include parts of the original sample of households and individuals questioned. The sample size varies over the years, due to a lack or refusal of follow-up, migration in and out of South Africa, deaths of individuals in previous waves as well as births.

There are several key issues that NIDS was designed to analyse. These include income and expenditure of households, demographic characteristics (age, sex, race), child health, employment, social capital and endowments as well as access to social services (Leibbrandt et al., 2009). To address these issues, NIDS has collected information on several factors, both at an individual and household level. Survey respondents were required to answer on behalf of all residents, including children, of each respective household. This dissertation draws on data from all four waves of the NIDS study. This will allow us to track the individuals and their actions over the four periods, which is one of the benefits of using longitudinal (panel) studies. We are able to study how the health of children evolves over time in relation to family structure, parental employment and education.

There are, however, a few limitations to using the NIDS data. In a demographic analysis of NIDS, Moultrie and Dorrington (2009) note that there is a relative incompleteness of the reporting of dates in the maternity histories. Branson et al. (2012) found that NIDS data estimated lower levels of educational attainment for White females under the age of 35, compared to other datasets. Many respondents are lost to follow-up in subsequent waves, either due to death, refusal to participate or an inability to be contacted. As children age, they may also move from the child dataset to the adult dataset.

While there are limitations to NIDS, numerous papers have commented on the reliability of the NIDS estimates. Ardington and Gasealahwe (2012) state that while there is evidence of measurement error in NIDS Waves 1 and 2, the data held enormous potential for the analysis of health in South Africa. The authors claim that the health data, in combination with the rich socioeconomic data, offer researchers an opportunity to study the links between health and socioeconomic status. Moultrie and Dorrington (2009) believe that while the sample size of the study in Wave 1 is relatively small, it is possible to draw reasonable estimates of fertility and mortality. Branson et al. (2012) find that the NIDS Wave 1 education estimates are in line with the other nationally representative surveys, and that certain questions asked in NIDS add value to analysing education in South Africa. After taking the aforementioned assessments into consideration, it is clear that the NIDS dataset holds the potential for important and necessary analysis. This nationally representative sample will allow us to investigate the relationship between paternal education and child health in South Africa.

3.2 Variables

The NIDS data comprises of parental and children files. To generate some of the variables regarding parents, we needed to merge the child and parent datasets. The child datasets did not include information on parental wealth and employment status. In order to generate parental education and employment variables, we needed to link the parents to their children. In the NIDS "individual derived" dataset, we are provided with the person identification (PID) number of some of the parents. We are able to merge the datasets by linking the PID of each child with the PIDs of his or her parents.

3.2.1 Dependent Variables

Throughout the literature, mortality has been the most common health indicator used in the analysis of child health in sub-Saharan Africa. However, Akachi and Canning (2010) believe decreasing mortality trends have occurred as a result of mortality intervention, and not necessarily improved nutrition. Since nutrition plays a large part of child health, we select height and weight outcomes as indicators of child health in this dissertation. In this study, child health outcomes are assessed by 3 variables:

- ***Height-for-Age (Children of all ages)***

In the NIDS individual-derived dataset, the height-for-age z-scores (HAZs) are presented for children at each wave. HAZ is a standardised measure, and is known to be a particularly good health indicator of short- and long-term health status (Chen and Li, 2009). Higher HAZs are more desirable from a child health perspective, while a lower HAZs is an indicator of poor health. Stunted children are defined as those with a HAZ score less than two standard deviations below the median (Semba et al., 2008, Wamani et al., 2004). The height-for-age z-score is defined as follows:

$$HAZ_i = \frac{h_{ij} - \bar{h}_j}{\sigma_j}$$

where h_{ij} is the observed height of child i in group j (sex and birth month), $\bar{h}_j$ is the median height in group j, and σ_j is the standard deviation of the height in group j. The cut-off points for HAZ are below -6 and above +6 (Mei and Grummer-Strawn, 2007). In NIDS, HAZ is standardised using the WHO international child growth standards (Casale, 2016). While most of the literature regarding HAZ is focused on infants, it has still been used as a health indicator for older children. (Arvay et al., 2005, Cao et al., 2013, Friedman et al., 2005, Desai et al., 2015)

Weight-for-Age (Children of all ages)

NIDS also measures the weight-for-age z-score (WAZ) of children in the NIDS individual-derived dataset, over all four waves. This will be used as another measurement of child health in this dissertation. While height is seen as a more accurate measure of long-term health, weight serves as a composite measure of stunting and wasting, and can be useful when analysing malnutrition (Aslam and Kingdon, 2012). A higher WAZ implies better health levels, and a WAZ lower than 2 standard deviations below the median can imply wasting (De Onis et al., 2006). However, a WAZ that is excessively high may imply that the child is overweight, or obese – a weakness of the WAZ measurement. The weight-for-age z-score is defined as follows:

$$WAZ_i = \frac{w_{ij} - \overline{w}_j}{\sigma_j}$$

where w_{ij} is the observed weight of child *i* in group *j* (sex and birth month), $\overline{w}_j$ is the median weight in group *j*, and σ_j is the standard deviation of the weight in group *j*. The cut-off points for WAZ are below -5 and above +5 (Mei and Grummer-Strawn, 2007). Similarly to height-for-age, WAZ is standardised against the WHO international child growth standards (Casale, 2016). Like HAZ, although uncommon, it is still possible for WAZ to be studied for school-going children who are older than 5 years of age (Arvay et al., 2005, Cao et al., 2013, Friedman et al., 2005, Desai et al., 2015)

- ***Perceived Health Status (Children of all ages)***

The last health indicator used in this dissertation is "perceived health status" (PHS). It is a self-reported health measure recorded by each NIDS surveyor regarding the health of the child in question. PHS is a discrete variable as it is ranked on a scale from 1 ("Excellent") to 5 ("Poor"). As noted by Ardington and Gasealahwe (2012), self-reported health status, in NIDS, was an efficient predictor of mortality. Furthermore, Chola and Alaba (2013) concluded that self-reported health in NIDS was not significantly affected by social capital, implying that this measure of health is robust. We must, however, remain cognizant of the fact that resident adults are reporting on the health of children, which may introduce bias due to human subjectivity.

3.2.2 Independent Variables

- ***Father's Presence and Education***

While the main focus of this dissertation is father's (paternal) education, it is imperative that this variable is analysed within a familial context. As a result, we combine the variable for "father's education" with that of "father's presence" in order to generate the main independent variable: Father's presence and education (DADPED). We compute DADPED as a categorical variable with six levels. These levels are presented as: "Present and No education", "Present and Primary", "Present and Secondary", "Present and Tertiary", "Died" and "Absent". This dissertation is focused on both the obtained education level and household presence of fathers; thus, the education levels of deceased and absent fathers are not studied.

- ***Other Control Variables***

MOMPED combines both maternal education level and maternal presence. Apart from parental education, much of the literature alludes to the economic impact parents could have on their child's health. To study this effect, we have included variables on the employment status of fathers, and of mothers. Employment is categorised as "unemployed" or "employed". We are unable to include variables for maternal and paternal income due to a lack of data.

Child's education level has been included in the regression. We want to understand if an increment in a child's grade improves his/her health. This variable is classified by the child's highest grade attained. Other variables relating to the child are age, sex and race. Age-squared in also included, in order to address the possibility of a non-linear relationship between age and the child health indicator variables. Child age ranges from 0 to 15.

Other variables of interest relate to the conditions in which a child's birth took place. We look at whether or not a medical professional (doctor, nurse) was present at the child's birth and also where the birth took place (hospital, clinic, home), as children born with complications may be more effectively treated by medical professionals in hospitals, leading to fewer health complications in later-life, than if they were born at home (Kennare et al., 2010). Lastly, we included a variable on the child's place of residence. This is coded as 1 for "rural/traditional", and 0 for "urban". The variables used, and their symbols, are presented in Table 3.1 below.

Table 3. 1: Description of Variables Used

	Variable	Description
Dependent Variables	HAZ	Child's height-for-age z-score
	WAZ	Child's weight-for-age z-score
	PHS	Child's perceived health status
Independent Variables	DADPED	Father's presence and education level
	MOMPED	Mother's presence and education level
	DADWORK	Father's employment status (1 if employed, 0 if not)
	MOMWORK	Mother's employment status (1 if employed, 0 if not)
	AGE	Age of child in years
	AGE2	Age of child in years, squared
	MALE	Child's sex (1 if male, 0 if female)
	RACE	Child's race
	CHEDUC	Child's education level
	POB	Place of birth
	MEDBIR	Medical personnel present at birth (1 if yes, 0 if no)
	RURAL	Type of dwelling (1 if rural, 0 if urban)

3.3 Methods

One commonly used longitudinal technique is fixed-effects (FE) regression, which exploits within-group variation of the variable of interest. In this dissertation, the education of fathers remains constant throughout the four waves, making FE regression inappropriate. Random-effects (RE) regression does not require variation within the variable of interest (Laird and Ware, 1982). We believe that the differences between subjects has some unobservable influence on our dependent variables. Variation across individuals is assumed to be uncorrelated with the predictor variables included in the model. After taking this into consideration, random-effects regression appears to be an appropriate method for this study.

We use the RE model to study the relationship between paternal education and three dependent child health indicators: HAZ, WAZ and PHS. A random-effects model is used to take the panel structure of the data into account. The regression model can be written as

$$y_{it} = \beta_0 + \beta x_{it} + \gamma z_i + \alpha_i + u_{it}$$

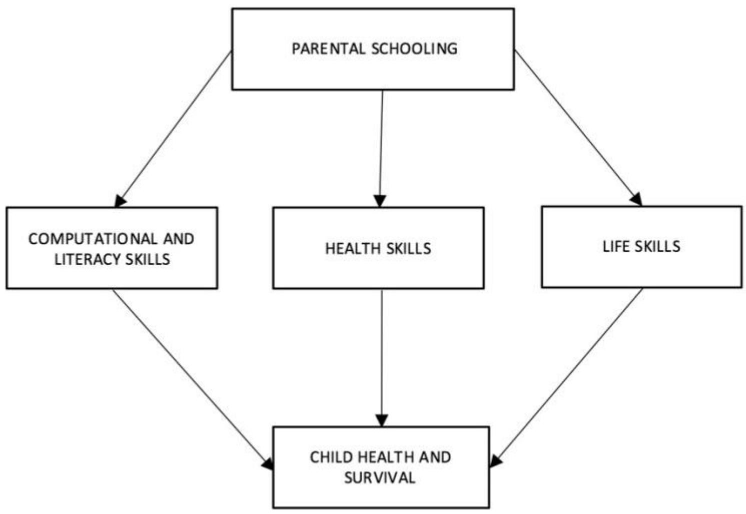
where β_0 is the intercept term, β and γ are coefficients for the xs and zs, x_{it} is the time-variant regressor, z_i is the time-invariant regressor, α_i is the unobserved individual effect and u_{it} is the error term. With RE regression, we are also able to include time-invariant characteristics, such as race and gender, two important characteristics found in the NIDS data. RE allows us to make inference about the population as a whole. RE models tend to be more efficient than FE models, due to their ability to calculate shrunken residuals (Clarke et al., 2010).

While RE regression is an appropriate statistical technique for a longitudinal study of the NIDS data, there still remain some drawbacks to this method. Firstly, as with the fixed-effects method, RE assumes that the source of bias is from omitted, time-invariant factors. The assumptions of this method are also strict – the random effects must be independent of the observed variables. It is also more difficult to get stable estimates of some parameters using this model (Ribar, 2004).

3.4 Theoretical Framework

In this section we present the theoretical framework underpinning the relationship between paternal education and child health.

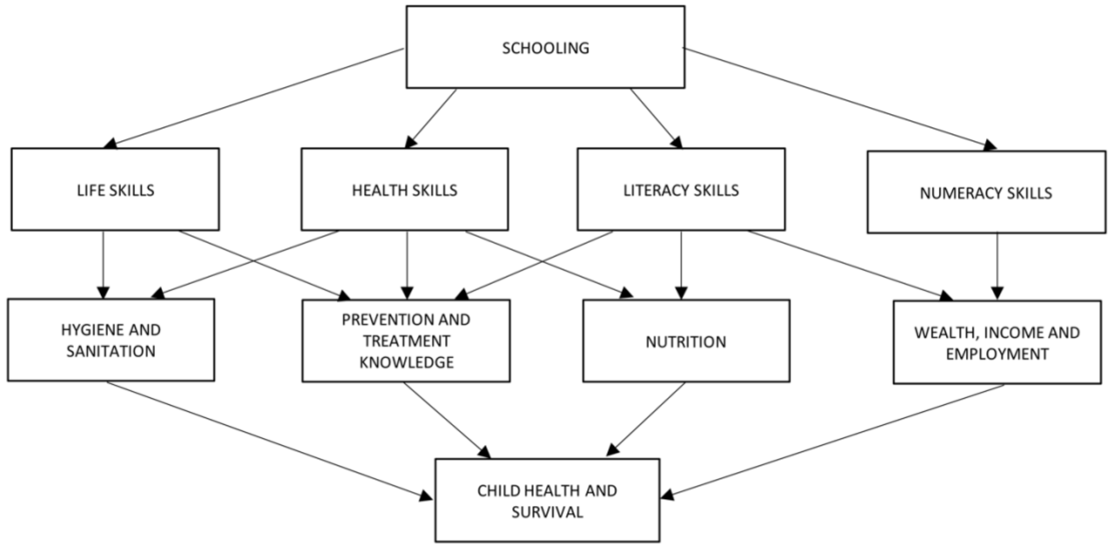
Figure 3. 1: The Determinants of Child Health – Simple Model



In Figure 3.1 we see how the education of parents during their childhood may directly lead to affecting the health of their children. This model has been inspired by the works of Le Vine et al. (1994) and Jain (1994). In the model, it is suggested that schooling of parents during their childhood leads to the attainment of three groups of skills, namely numeracy and literacy skills, health skills and life skills. These are then assumed to impact child health.

Figure 3.2 expands on the Simple-School Model derived from Le Vine et al. and Jain's models. It does this by illustrating the possible skills and pathways through which the major determinants work in order to impact child health. For instance, Life Skills gained at school may impact child health by educating the potential parent on hygienic behaviour, and disease prevention. Health skills learned may also affect these two behaviours, in addition to educating people about proper nutrition. Literacy skills equip children with the ability to comprehend health messaging, and to communicate effectively with health practitioners.

Figure 3. 2: The Determinants of Child Health – Complex Model



There are numerous mechanisms and pathways through which parental education may influence child health, both directly and indirectly. While males and females may be taught the same skills during childhood, the way in which they implement these skills tends to be different in the real world. Furthermore, females may be taught skills unique to their sex, such as breastfeeding. We also see a differing effect when it comes to income generation, as males tend to be the primary income generators in African households, although this is changing.

Chapter 4

Results

The following chapter presents the results of this dissertation. Section 4.1 compares the study sample with the sample of attrition. Section 4.2 describes the sample. Lastly, Section 4.3 presents the results.

4.1 Comparison of Study Sample with Sample of Attrition

Figure 4.1 presents attrition found in the NIDS child dataset. We are able to follow the number of children who join, remain in or leave the study, over the course of the four waves. From the figure, we see that 9605 children are present in Wave 1. From this, 7871 children remain in Wave 2 of NIDS. 6737 of the children who were present in Waves 1 and 2 then move on to Wave 3. Finally, we see that 5101 children have remained throughout Waves 1 to 4 (W1234). This represents 53% of the initial sample size of 9605. There were relatively large samples of children who occurred solely in Wave 3 (3158 children) and only Wave 4 (4803 children), which is indicated in the boxes.

Figure 4. 1: Number of Children in Each NIDS Wave

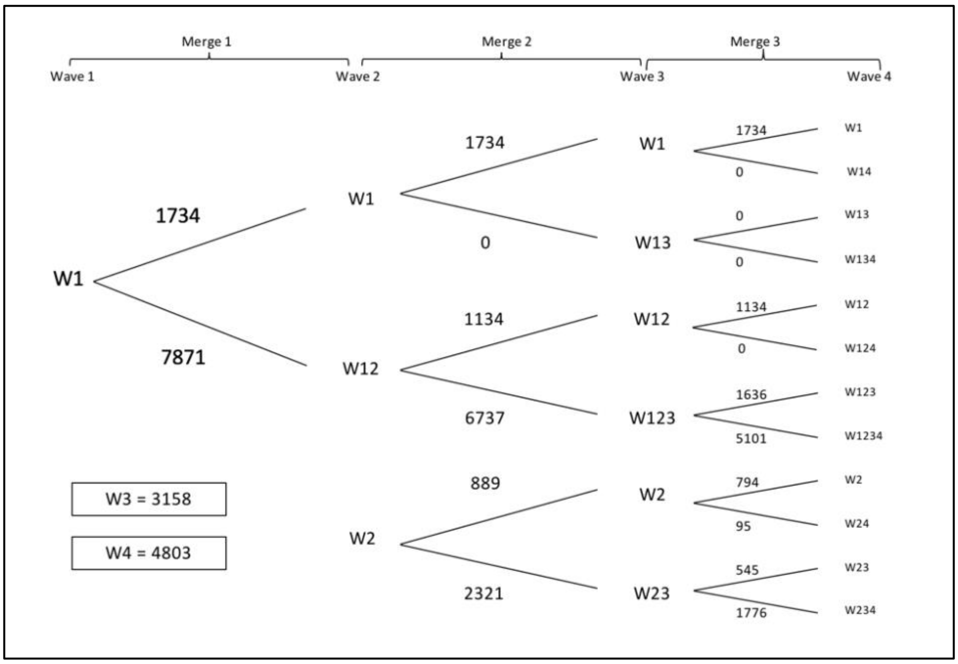


Table 4.1 summarizes the number of children and adults who appear in each combination of waves. Overall, 20776 children were used across all four waves of NIDS and 33547 adults were involved in the study. One important point to note is that NIDS Wave 3 occurred in 2012, making it the first NIDS study to occur after the 2011 census. As a result, the NIDS Wave 3 dataset V1.2 has been reweighted to take the census geographical data into account, both at an individual and household level.

Table 4. 1: Number of Children and Adults in Each NIDS Wave

Wave	Children (N)	Adults (N)
1	1734	757
1 2	1134	714
1 2 3	1636	1037
1 2 3 4	5101	12659
1 2 4	0	1083
1 3	0	56
1 3 4	0	437
1 4	0	128
2	794	1591
2 3	545	923
2 3 4	1776	3295
2 4	95	578
3	3158	4059
4	4803	6230
Total	20776	33547

We need to assess if attrition in the dataset is random or not. Table 4.2 compares the percentage distribution of all variables relating to the sample of children who remain in the study for at least two consecutive waves (“remain”), with those children who are not in at least two consecutive waves (“dropped out”). These figures are for the first wave that respondents are present in the study. We see that deceased fathers are more prevalent in the sample of those who have dropped out (26.2%), while the percentage of missing fathers (62.6%) is greater for those children who remain in the NIDS study. 56.2% of fathers who remain in the study are employed, while 61.4% who drop out are employed. For mothers, 44.4% who remain in the study are employed and 50.9% of mothers who leave are employed. The split between child sex is roughly equal for both samples. Child’s race, place of birth, medical professional at birth and type of dwelling are all fairly consistent between the two samples. There are two variables that differ substantially between the samples: the age of the child and the child’s education level. The age disparity is expected, as those who drop out at a later stage should have increased in age. Child’s education level is also greater for those who have dropped out as we expect children leaving the study to have attained more education than when they first entered the study. From this table we are not able to conclude that attrition in this dataset is random.

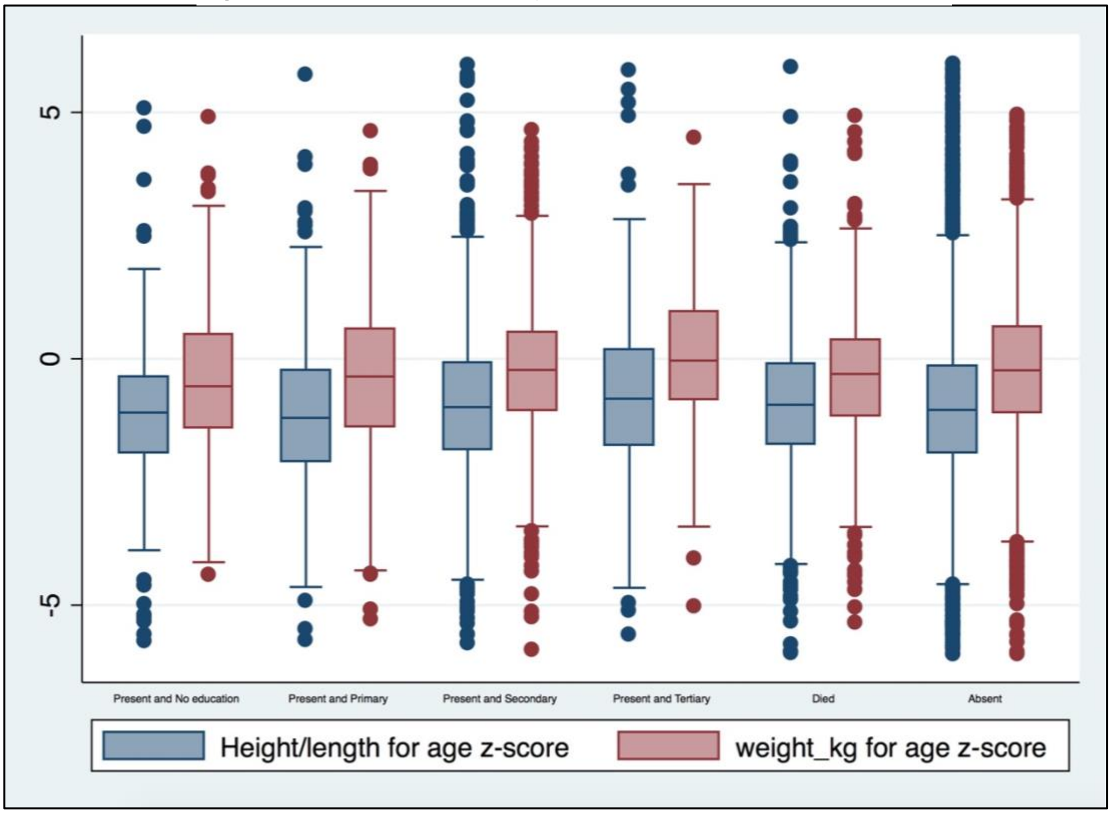
Table 4. 2: Percentage Distribution of Variables

	Remain	Dropped out
Father's presence and education		
Present and No education	2.34	3.07
Present and Primary	4.62	5.51
Present and Secondary	15.38	14.17
Present and Tertiary	3.24	2.58
Died	11.84	26.17
Absent	62.57	48.50
Mother's presence and education		
Present and No education	3.72	5.54
Present and Primary	13.31	14.90
Present and Secondary	42.57	26.83
Present and Tertiary	7.49	5.61
Died	5.71	12.16
Absent	27.20	34.95
Father's employment status		
Unemployed	43.77	38.62
Employed	56.23	61.38
Mother's employment status		
Unemployed	55.57	49.09
Employed	44.43	50.91
Child's age		
0-5	59.04	10.49
6-15	40.96	89.51
Sex of child		
Female	50.01	49.89
Male	49.99	50.11
Race of child		
African	84.19	84.00
Coloured	13.00	12.85
Asian/Indian	0.87	0.92
White	1.95	2.23
Child's education in years		
Junior Primary	40.38	25.69
Senior Primary	11.87	57.88
High school or more	0.27	5.83
No Schooling	47.48	10.61
Place of birth		
Hospital	83.02	81.89
Clinic	10.76	10.02
Home	6.22	8.09
Medical personnel at birth		
No	5.85	7.03
Yes	89.01	86.49
Don't know/Missing	5.14	6.47
Type of dwelling		
Urban	42.14	41.07
Rural/Traditional	57.86	58.93

4.2 Description of the Dependent Variables

The main health indicators (dependent variables) in this dissertation are height-for-age z-score (HAZ), weight-for-age z-score (WAZ) and perceived health status (PHS). The sample used in this study is children who are present in at least two consecutive NIDS waves. Therefore, it is possible that new children appear in waves three and four. All descriptive statistics presented are for the first wave in which children are present in the NIDS survey. Figure 4.2 displays the box-plots of HAZ and WAZ over the different levels of paternal presence and education. From the figure we can see that children whose fathers are present with higher education have the highest HAZs and WAZs, followed by those whose fathers have secondary education. We see that children with absent or deceased fathers have higher HAZs and WAZs than those whose fathers have primary or no education.

Figure 4. 2: HAZ and WAZ by Father's Presence and Education



In Figure 4.3 we present the percentage distribution of the number of children by each level of PHS (at Wave 1), which is categorised as: "Poor", "Fair", "Good", "Very good" or "Excellent". Children of "excellent" health are most prevalent in the study, comprising of roughly 50% of the sample. Thereafter, 31% of children are of "very good" health, 16% of "good" health, with the remaining 2 - 4% having either "fair" or "poor" health.

Figure 4. 3: Distribution of Perceived Health Status by Category

Table 4.3 presents the mean and standard deviation (in parentheses) for HAZ, WAZ and PHS, at each level of the independent variables use in this study. The sample sizes (n) corresponding to each respective category of all variables are also presented. In terms of height-for-age, children whose fathers were present with no education produced the lowest z-scores (-1.171). The average HAZs increased as educational attainment increased. Children whose fathers were present with tertiary education had the highest z-scores (-0.676). The average z-scores of those children with absent or deceased fathers fall between "Present and Primary" (-1.116) and "Present and Secondary" (-0.943). Similar to HAZ, the lowest average WAZ was for children whose fathers were present and uneducated (-0.451). As the education level of fathers increases, so do the average WAZs. "Present and Tertiary" has the highest WAZ of -0.001. The average WAZ of children with deceased fathers (-0.371) ranks between those whose fathers have no education and those whose fathers have primary education. "Absent" produced the same average WAZ as "Present and Secondary" (-0.224). The average perceived health status varied over all categories. Children with non-educated fathers had the lowest PHS score (1.688), while children with deceased fathers had the highest PHS score (1.833).

Table 4. 3: Summary Statistics of Variables of Interest

	HAZ		WAZ		PHS	
	Mean (SD)	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**n**
Father's presence and education						
Present and No education	-1.171 (1.665)	172	-0.451 (1.687)	132	1.688 (1.152)	215
Present and Primary	-1.116 (1.551)	328	-0.342 (1.612)	281	1.787 (0.927)	423
Present and Secondary	-0.943 (1.584)	1023	-0.224 (1.437)	930	1.794 (0.908)	1400
Present and Tertiary	-0.676 (1.681)	209	-0.001 (1.376)	197	1.776 (0.951)	294
Died	-0.951 (1.407)	876	-0.371 (1.353)	602	1.833 (0.947)	1087
Absent	-0.985 (1.685)	3900	-0.224 (1.495)	3483	1.799 (0.932)	5743
Mother's presence and education						
Present and No education	-1.004 (1.396)	337	-0.434 (1.367)	252	1.733 (0.835)	424
Present and Primary	-1.155 (1.623)	1089	-0.533 (1.537)	867	1.826 (0.942)	1514
Present and Secondary	-0.964 (1.704)	3145	-0.193 (1.479)	2930	1.742 (0.922)	4831
Present and Tertiary	-0.588 (1.632)	544	0.178 (1.471)	515	1.699 (0.855)	847
Died	-1.044 (1.322)	556	-0.507 (1.439)	352	1.903 (1.185)	651
Absent	-0.934 (1.493)	2440	-0.236 (1.429)	1927	1.837 (0.956)	3099
Father's employment status						
Unemployed	-0.965 (1.664)	2670	-0.218 (1.501)	2366	1.865 (0.994)	3602
Employed	-0.982 (1.598)	3161	-0.239 (1.441)	2718	1.766 (0.906)	4583
Mother's employment status						
Unemployed	-0.965 (1.590)	3607	-0.276 (1.489)	3082	1.836 (0.972)	4806
Employed	-0.884 (1.450)	2749	-0.202 (1.397)	2228	1.788 (0.934)	3807
Child's age						
0-5	-1.069 (1.823)	4406	-0.151 (1.522)	4599	1.770 (0.906)	7050
6-15	-0.844 (1.299)	4110	-0.413 (1.381)	2580	1.807 (0.997)	4959
Sex of child						
Female	-0.876 (1.593)	4283	-0.200 (1.475)	3591	1.766 (0.936)	6016
Male	-1.046 (1.594)	4232	-0.291 (1.480)	3588	1.804 (0.955)	5995
Race of child						
African	-0.957 (1.603)	7365	-0.213 (1.474)	6240	1.813 (0.954)	10141
Coloured	-1.134 (1.481)	963	-0.612 (1.473)	772	1.643 (0.895)	1547
Asian/Indian	-0.569 (1.450)	60	-0.327 (1.362)	51	1.553 (0.798)	94
White	-0.020 (1.715)	128	0.504 (1.284)	116	1.591 (0.811)	232
Child's education in years						
Junior Primary	-0.870 (1.403)	3727	-0.344 (1.424)	3311	1.802 (0.995)	4829
Senior Primary	-0.896 (1.270)	1161	-0.295 (1.402)	96	1.772 (0.909)	1412
High school or more	-0.963 (1.731)	19	-0.584 (1.144)	14	1.758 (1.001)	33
No Schooling	-1.073 (1.850)	3554	-0.154 (1.524)	3706	1.773 (0.912)	5665
Place of birth						
Hospital	-0.936 (1.591)	6929	-0.224 (1.478)	5874	1.760 (0.930)	9871
Clinic	-0.963 (1.661)	921	-0.210 (1.464)	782	1.890 (0.916)	1279
Home	-1.270 (1.542)	582	-0.605 (1.459)	468	2.000 (0.969)	740
Medical personnel at birth						
No	-1.262 (1.590)	549	-0.526 (1.501)	454	1.969 (0.947)	702
Yes	-0.947 (1.607)	7489	-0.223 (1.479)	6376	1.776 (0.937)	10672
Don't know/Missing	-0.838 (1.331)	461	-0.301 (1.401)	334	1.724 (1.071)	616
Type of dwelling						
Urban	-0.947 (1.570)	3249	-0.250 (1.528)	2736	1.762 (0.975)	4979
Rural/Traditional	-0.970 (1.612)	5258	-0.242 (1.446)	4435	1.801 (0.925)	7014
All	-0.960 (1.596)		-0.245 (1.478)		1.785 (0.946)	

Children with deceased mothers had the lowest average HAZ (-1.044), while those whose mothers had tertiary education had the highest HAZ (-0.588). Average HAZ increased from primary to tertiary levels. Children with absent mothers had an average HAZ of -0.934, which places between secondary (-0.964) and Tertiary education. In terms of weight-for-age, children with mothers who have obtained higher education presented with the highest average z-score (0.178). The lowest average WAZ was for children whose mothers had only primary education (-0.533). This was followed by children with deceased mothers (-0.507). Average WAZ increased as education increased from primary through to tertiary. The PHS scores relating to maternal education presented a more logical pattern than those relating to paternal education. The average PHS score decreased as education level increased, with the exception of those with uneducated mothers (1.733). Primary education had a PHS score of 1.826, while Tertiary education had the lowest average PHS score (1.699). This implies that those whose mothers had obtained tertiary education were healthier, on average, according to the PHS.

Perceived health status was lower (better) for children with employed fathers than those whose fathers were unemployed or absent. HAZ and WAZ for children with employed mothers was higher compared to children with unemployed or absent mothers. PHS was lower for children with employed mothers (1.771) than other children. Average height-for-age z-score was highest for children who live both parents (-0.927). WAZ was highest for children living with either mothers only or fathers only (both -0.211). Perceived health status was lowest for children living with both parents. Female children presented with higher HAZs and WAZs than male children. Girls also had a lower average perceived health status (1.766) than boys (1.804). White children had the highest HAZ (-0.020). White children also had the highest average WAZ (0.504). Indian children had the lowest PHS (1.553). Children born in hospitals had the highest HAZ (-0.936) and the second highest WAZ (-0.224).

Children born in hospitals also had the lowest PHS score (1.760), followed by children born in clinics, and then those born at home. Children whose births were overseen by doctors or nurses had higher average HAZs and WAZs than those who were not. PHS was also lower for children born in the presence of a doctor or nurse. The age groups are divided into "0 to 5" and "6 to 15". The older age-group presented with higher HAZs and lower WAZs, than the younger group. PHS was marginally lower for the younger group (1.770) than for the older group (1.807). The distribution of child age is presented in Table A.2 in the Appendix. When looking at the pattern of child education level, we see that average HAZ decreased as child education level increased. Children in urban dwellings had higher HAZs (-0.947) than those in rural dwellings (-0.970). Children from urban areas also had a better average perceived health status score (1.762) than those from rural areas (1.801).

4.3 Regression Analysis

Tables 4.4 to 4.6 display the random effects (RE) estimates of the three health variables HAZ, WAZ and PHS. Regressions are performed for children of all ages, ages 0 to 5 and 6 to 15. The reason for this age segmentation is to investigate whether parental influence may be greater during the early stages of a child's development or later in childhood. The tables present the co-efficients derived from the regressions and the standard errors of these coefficients.

4.3.1 Effect on Height-for-Age

Table 4.4 presents the estimates of the coefficients obtained from the RE regression of HAZ. The results show that as the education of fathers increases, so too does the HAZ of children. For instance, compared to children whose fathers are present and have no education, children whose fathers have primary level of education have significantly larger height-for-age z-scores (0.164), all other factors remaining constant. This value increases as fathers' education level increases. The results also show that children who live without their fathers have significantly higher HAZs compared to children who live with fathers who have no formal education. Furthermore, there are no significant effects when the child's father is not alive. In both age groups, children whose fathers obtained tertiary education had HAZs that were significantly greater than children whose fathers had no education. In the "6 – 15" age group, children whose fathers were present with secondary education had significantly larger height-for-age z-scores than those whose fathers were uneducated and present. In the two age-groups, there were no significant effects for children whose fathers had primary education or died. Children whose fathers were absent still had significantly higher HAZs than those with fathers who have no education.

The estimates relating to maternal education presented a similar pattern to paternal education. The HAZ of children increased as the level of education obtained by mothers increased. Children whose mothers were present with secondary education had significantly higher HAZs than children whose mothers had no education (0.255). Furthermore, children with mothers who have studied at a higher level have significantly larger HAZs than children with uneducated but present mothers (0.498). There was no significant effect for children whose mothers had primary education only, or for those whose mothers are not alive. The results also show that children with absent mothers have significantly higher z-scores than those with uneducated mothers. For the age group "0 – 5", only those with mothers who have primary education failed to have significantly greater HAZs than those with uneducated mothers. All other categories, including deceased and absent, had significantly higher HAZs than those whose mothers had no education. For the older group, only two levels of MOMPED failed to show any significant effects: primary education (0.074) and deceased (0.033).

Paternal employment did not have any significant effect on HAZ. However, children whose mothers were employed had significantly higher HAZs than children with unemployed mothers. This effect was carried through by the older age-group. Factors directly relating to the child, such as age, gender, race and education are all significantly related to height-for-age z-score. In terms of race, Coloured children had significantly lower HAZs (-0.089) than African children, while Indian (0.550) and White (0.613) children had significantly larger HAZs than African children. Child's education level had a significantly negative effect on HAZ. This effect was brought through by the education of children older than 5, where child's education level had a p-value of 0.073. Children born at home had significantly lower (-0.331) height-for-age z-scores than those born in hospitals. A medical professional's presence at birth was not a significant predictor of HAZ for any age group. Living in a rural dwelling had a significantly negative effect on HAZ for the older age-group only.

Table A.4 in the Appendix shows the results of how HAZ is affected when we include maternal BMI in the regression. From the output, we see that maternal BMI has a significant effect on HAZ. We see that the introduction of maternal BMI has not attenuated the effect that paternal presence and education has on child height-for-age. The regression presented in Table A.5 removes paternal and maternal employment and introduces household income level as an independent variable. This variable ranges downward from 1 to 5, with 1 being "Much above average income" and 5 being "Much below average income". Here, the sample size is reduced dramatically to 3448. Only the category, "much above average income", has a significant effect on HAZ. Even after income has been added, father's tertiary education still shows a significant effect, at a 10% level.

Table 4. 4: Random-Effects estimates for HAZ

Variable	All Ages		0 - 5		6 - 15	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Father's presence and education						
Present and No education (Base)						
Present and Primary	0.164*	0.085	0.242	0.187	0.133	0.089
Present and Secondary	0.223***	0.076	0.276	0.168	0.204**	0.080
Present and Tertiary	0.380***	0.084	0.514***	0.181	0.311***	0.090
Died	0.121	0.078	0.086	0.183	0.112	0.081
Absent	0.212***	0.075	0.339**	0.166	0.162**	0.079
Mother's presence and education						
Present and No education (Base)						
Present and Primary	0.091	0.078	0.159	0.174	0.074	0.082
Present and Secondary	0.255***	0.073	0.404**	0.164	0.217***	0.077
Present and Tertiary	0.498***	0.078	0.719***	0.171	0.402***	0.083
Died	0.127	0.082	0.516***	0.201	0.033	0.084
Absent	0.240***	0.075	0.545***	0.168	0.143*	0.078
Father is employed	-0.006	0.024	0.030	0.045	-0.022	0.027
Mother is employed	0.074***	0.023	0.043	0.043	0.102***	0.026
Age	0.052***	0.013	-0.505***	0.051	0.025	0.043
Age squared	-0.004***	0.001	0.087***	0.009	-0.004*	0.002
Male child	-0.142***	0.022	-0.200***	0.041	-0.103***	0.025
Race of child						
African (Base)						
Coloured	-0.089**	0.037	-0.007	0.068	-0.140***	0.041
Asian/Indian	0.550***	0.175	0.984**	0.465	0.439**	0.173
White	0.613***	0.110	0.595***	0.218	0.600***	0.121
Child's education level (grade)	-0.010***	0.001	-0.000	0.002	-0.005*	0.003
Place of birth						
Hospital (Base)						
Clinic	0.034	0.036	-0.007	0.064	0.072*	0.043
Home	-0.331***	0.088	-0.488***	0.182	-0.280***	0.094
Medical personnel at birth						
No (Base)						
Yes	-0.128	0.089	-0.190	0.179	-0.106	0.097
Don't know/Missing	-0.077	0.112	0.064	0.233	-0.125	0.121
Rural dwelling	-0.029	0.024	0.013	0.046	-0.058**	0.027
Constant	-1.147***	0.144	-1.016***	0.292	-0.813***	0.252
N	15123		5554		9569	
R^2	0.0315		0.0436		0.0459	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3.2 Effect on Weight-for-Age

Table 4.5 presents the estimates of the coefficients obtained from the RE regression of WAZ. As paternal education level increases so does the weight-for-age z-score of the child, holding everything else constant. Fathers having only primary education did not have any significant influence on WAZ. Children whose fathers were present and had secondary (0.234) or tertiary (0.381) education had significantly larger z-scorers than children whose fathers were not educated. Children with deceased fathers had significantly larger WAZs than children whose fathers were present and had no education (0.169). Children with absent fathers also had larger z-scores (0.185) than those whose fathers had no education. For the age-group “0 – 5”, increasing levels of paternal education had no significant effect on WAZ. For the older age group, only “Present and Primary” failed to have a significant effect on WAZ. Children aged 6 to 15, whose fathers were present with secondary or tertiary education, had significantly larger WAZs than children with uneducated but present fathers. For the older group, children whose fathers were deceased or absent still had significantly higher WAZs than those with present, uneducated fathers.

As the level of maternal education increases, so does child WAZ. Maternal tertiary education had the most substantial, significant impact on child WAZ (0.523). Children whose mothers had only secondary education also had larger z-scores than children with uneducated mothers (0.260). Children with present mothers who have primary education had larger WAZs than children with mothers who have no education. Children with deceased mothers did not have significantly different WAZs than those with alive and uneducated mothers. Children with absent mothers did, however, have significantly greater WAZs than those children with present, yet uneducated mothers. Both of the age groups experienced the same effects of maternal education on WAZ with one exception: for the group “0 – 5”, children whose mothers had primary education did not have significantly larger z-scores than those with uneducated mothers.

Child WAZ was not significantly affected by paternal employment. Conversely, those whose mothers were employed had significantly larger WAZs than those with unemployed mothers. This was true for both age-groups as well. Age had a significantly negative effect on WAZ. Male children had significantly lower WAZs than female children. Coloured children had significantly lower WAZs (-0.323) than African children with White children having significantly larger WAZs than African children (0.358). Child’s education level had a significantly negative effect on WAZ. This effect was brought through by the education of children older than 5. Children born in clinics did not have significantly different WAZs than those born in hospitals. However, children born at home had significantly smaller WAZs (-0.363) than those born in hospitals. A medical professional’s presence at birth was not a significant predictor of WAZ for any age group. Furthermore, living in a rural dwelling had no significant effect on WAZ.

Table A.4 in the Appendix shows how maternal BMI z-score affects WAZ. After the introduction of this variable, paternal secondary and tertiary education remain significant determinants of child WAZ. Maternal BMI is associated with child WAZ at a 1% level. There is insufficient household income data to conduct a regression analysis for WAZ, in Table A.5.

Table 4. 5: Random-Effects Estimates for WAZ

Variable	All Ages		0 - 5		6 - 15	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Father's presence and education						
Present and No education (Base)						
Present and Primary	0.119	0.107	0.094	0.161	0.105	0.140
Present and Secondary	0.234**	0.095	0.082	0.145	0.347***	0.125
Present and Tertiary	0.381***	0.104	0.183	0.157	0.556***	0.139
Died	0.169*	0.100	0.010	0.159	0.268**	0.128
Absent	0.185**	0.094	0.074	0.143	0.253**	0.124
Mother's presence and education						
Present and No education (Base)						
Present and Primary	0.173*	0.097	0.138	0.150	0.209*	0.126
Present and Secondary	0.260***	0.091	0.263*	0.140	0.259**	0.117
Present and Tertiary	0.523***	0.096	0.556***	0.147	0.483***	0.126
Died	0.169	0.105	0.170	0.173	0.169	0.131
Absent	0.327***	0.093	0.385***	0.144	0.284**	0.120
Father is employed	0.024	0.027	0.034	0.039	0.017	0.038
Mother is employed	0.114***	0.027	0.102***	0.038	0.125***	0.038
Age	-0.178***	0.018	-0.308***	0.044	-0.069	0.211
Age squared	0.012***	0.002	0.034***	0.008	0.002	0.014
Male child	-0.098***	0.025	-0.079**	0.036	-0.122***	0.036
Race of child						
African (Base)						
Coloured	-0.323***	0.043	-0.242***	0.059	-0.424***	0.061
Asian/Indian	-0.014	0.228	-0.154	0.408	0.037	0.268
White	0.358***	0.134	0.307	0.188	0.425**	0.190
Child's education level (grade)	-0.004***	0.001	0.000	0.002	-0.006**	0.003
Place of birth						
Hospital (Base)						
Clinic	-0.024	0.041	-0.039	0.055	0.003	0.061
Home	-0.363***	0.108	-0.413***	0.155	-0.355**	0.150
Medical personnel at birth						
No (Base)						
Yes	-0.063	0.109	0.006	0.151	-0.158	0.156
Don't know/Missing	-0.066	0.137	0.075	0.199	-0.204	0.188
Rural dwelling	-0.001	0.028	0.035	0.039	-0.048	0.040
Constant	-0.112	0.172	-0.072	0.247	-0.247	0.832
N	10567		5721		4846	
R^2	0.0409		0.0447		0.0386	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3.3 Effect on Perceived Health Status

The results of the perceived health status (PHS) regression are presented in Table 4.6 below. Since this variable ranges from 1 ("Excellent") to 5 ("Poor"), a variable having a negative effect on PHS is desirable, from a child health perspective. Children whose fathers are present with primary education do not experience significantly different PHS scores to those whose fathers are present and uneducated. The same holds for children whose fathers have obtained secondary education or higher, all else remaining constant. Children with deceased (0.090) or absent (0.080) fathers do, however, have significantly higher PHS scores than those whose fathers are present and uneducated, implying that they are less healthy than those children who have present fathers with no education. This effect is also seen in the older age group.

The effect of maternal education on PHS differs to the effect of paternal education. As the education level of mothers increases, PHS decreases. This means that greater maternal education is found to improve child health, as implied by the negative effect on PHS. Children whose mothers have only secondary education have significantly lower PHS scores than those whose mothers are uneducated (-0.091). Those whose mothers have higher education also present with significantly lower PHS scores (-0.116). Primary education of mothers did not have any significant influence on the perceived health status of the child. The results show that children whose mothers were either absent or deceased did not have a significantly different PHS to those children whose mothers were not educated, with one exception. For children aged 0 to 5, those whose mothers are not alive had significantly larger PHS scores than those whose mothers were present and uneducated (0.180).

The results show that paternal employment did have a significant on PHS. Those with employed fathers had significantly lower PHS scores than those with unemployed fathers (-0.042). This held for both age groups as well. Maternal employment failed to have any pronounced effect on PHS. As the age of children increased, so too did their PHS scores. Male children had significantly higher PHS scores than female children (0.030). Coloured and Indian children had significantly lower perceived health status scores than African children. Those children born at clinics did not have significantly different health statuses to those born in hospitals. However, children born at home had significantly larger PHS scores than children who had hospital births (0.097). Having a medical professional present at birth had a significantly negative effect on PHS scores. Lastly, children living in rural areas had significantly lower PHS scores than those living in urban areas.

In table A.4 the Appendix, we see no level of paternal education is strongly associated with PHS, however, maternal BMI is significantly associated with PHS, at a 1% level. PHS was not significantly affected by household income, however, even though the sample size has been reduced substantially, we find that paternal primary education has a significant effect on PHS. Dead and absent fathers also have a significant effect on child PHS, at a 5% level.

Table 4. 6: Random-Effects Estimates for PHS

Variable	All Ages		0 - 5		6 - 15	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Father's presence and education						
Present and No education (Base)						
Present and Primary	0.074	0.053	0.026	0.096	0.096	0.063
Present and Secondary	0.017	0.047	-0.017	0.087	0.036	0.057
Present and Tertiary	0.052	0.052	0.072	0.094	0.036	0.064
Died	0.090*	0.049	0.087	0.095	0.103*	0.057
Absent	0.080*	0.047	0.059	0.086	0.092*	0.056
Mother's presence and education						
Present and No education (Base)						
Present and Primary	-0.002	0.048	-0.053	0.087	0.023	0.057
Present and Secondary	-0.091**	0.045	-0.080	0.081	-0.099*	0.054
Present and Tertiary	-0.116**	0.048	-0.111	0.085	-0.115**	0.058
Died	0.025	0.050	0.180*	0.102	-0.009	0.059
Absent	0.001	0.046	0.031	0.084	-0.018	0.055
Father is employed	-0.042***	0.014	-0.054**	0.023	-0.035*	0.019
Mother is employed	-0.005	0.014	-0.006	0.022	-0.006	0.019
Age	0.016**	0.007	0.030**	0.015	0.018	0.030
Age squared	-0.001***	0.000	-0.004	0.003	-0.001	0.002
Male child	0.030**	0.013	0.050**	0.021	0.017	0.017
Race of child						
African (Base)						
Coloured	-0.127***	0.022	-0.138***	0.034	-0.119***	0.029
Asian/Indian	-0.231**	0.103	-0.199	0.196	-0.250**	0.121
White	-0.079	0.065	-0.097	0.112	-0.072	0.079
Child's education level (grade)	-0.000	0.001	-0.002*	0.001	0.003*	0.002
Place of birth						
Hospital (Base)						
Clinic	0.036	0.022	0.0341	0.032	0.040	0.030
Home	0.097*	0.054	0.238***	0.090	0.013	0.067
Medical personnel at birth						
No (Base)						
Yes	-0.090**	0.054	0.022	0.087	-0.173**	0.070
Don't know/Missing	-0.298***	0.068	-0.213*	0.113	-0.366***	0.085
Rural dwelling	-0.066***	0.015	-0.051**	0.023	-0.075***	0.019
Constant	1.886***	0.086	1.808***	0.143	1.942***	0.178
N	17395		7027		10368	
R^2	0.0118		0.0157		0.0123	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Chapter 5

Discussion and Conclusions

This dissertation aimed to fill the gap in the literature by analysing the influence of paternal education on child health in a South African context. The first aim of this dissertation was to explore the effect of the education of fathers on child health by separating fathers' income generating role from fathers' education. This was done by examining paternal education and paternal employment separately. The second aim relates to analysing how the effect of paternal education on child health varies by fathers' presence in the household. After an extensive search on the literature surrounding this topic, it became evident that paternal education alone would not suffice as an effective variable of interest. Due to the high rate of paternal family abandonment in sub-Saharan Africa, it was necessary to include information on whether fathers were present in the household, had left the household, or were no longer living.

To explore the effects of paternal education on child health, we perform a longitudinal analysis over the four waves of the NIDS study using random-effects (RE) regression. In this dissertation, the main independent variable is "father's presence and education". This categorical variable includes "deceased", "absent" as well as the education levels none, primary, secondary and higher. We include variables on paternal presence and death in order to investigate if fathers being present in the household has any effect on child health. The health indicators used are height-for-age z-score (HAZ), weight-for-age z-score (WAZ) and perceived health status (PHS), which is a subjective health measure recorded by the NIDS surveyors. In this study we are able to find evidence of fathers' education and presence being a significant determinant of child height-for-age and weight-for-age. These results imply that an increased educational attainment of fathers lead to improved health of their children. We are not able to expose any significant relationship between paternal education and the NIDS perceived health status score, however maternal education proved to be a significant determinant of PHS. Furthermore, we are not able to conclusively infer a causal relationship between paternal education and child health.

This dissertation's results suggest that as paternal education level increases, so too does child height-for-age z-score. Children whose fathers were present with primary (0.164), secondary (0.223) or tertiary (0.380) education had significantly larger HAZs than children whose fathers were not educated. Children whose fathers were absent also had significantly larger HAZs (0.212) than those with uneducated fathers. This implies that the education of absent fathers may be worth investigating. Tertiary paternal education remained significant for both of the separated age groups. Paternal absence was also a significant determinant of HAZ for the younger and older age groups. Contrary to our findings, Wamani et al. (2004) could not unveil any significant influence on child height by father's education. Semba et al. (2008) found paternal education to be a stronger determinant of childhood stunting than maternal education, in rural Bangladesh and Indonesia. From our results, we were not able to reach the same conclusion, as evidenced by the higher coefficients of maternal education in the HAZ regression, compared to the paternal education coefficients. However, the results do not dismiss the significant, positive effect that paternal education and presence have on child health.

In this dissertation, we see that as the level of paternal education increased, so did WAZ. Children whose fathers had secondary (0.234) or tertiary education (0.381) had significantly greater z-scores than those whose fathers did not have any education. Children whose fathers were either dead (0.169) or absent (0.185) also had significantly larger WAZs than those with present but uneducated fathers. The older age-group experienced the exact same pattern of significance as the entire sample. For the younger age-group, none of the levels of father's education and presence significantly affected weight-for-age. Most of the literature fails to find any association between paternal education and WAZ. Aslam and Kingdon (2012) find paternal education to have no significant effect on child weight-for-age or height-for-age. The researchers find that father's education only affects "health seeking behaviour". In this dissertation, however, we see evidence of paternal education having a significant and positive impact on child height and weight, two markers of child health.

The final child health proxy analysed in this dissertation was perceived health status (PHS). To our knowledge, this is the first study to analyse parental education as a determinant of the NIDS perceived health status indicator. In the regression analysis, we were unable to find any significant link between paternal education and the PHS variable. This finding contradicts the results generated from analysing the other two health indicators, HAZ and WAZ. The only significant effect experienced by the "paternal presence and education" variable was that children whose fathers are absent (0.080) or deceased (0.090) had significantly greater PHS scores than those whose fathers are present and uneducated. This implies that even though some present fathers are uneducated, their children are still healthier than those children with deceased or absent fathers. Children whose fathers were employed had significantly higher PHS scores than those with unemployed fathers. Since education has been known to positively affect employment, it may be the case that paternal education has indirectly influenced PHS via the mechanism of paternal employment, as suggested by Glewwe (1999).

Mothers remained significant determining agents of child health. In the regression analysis, maternal secondary (0.255) and tertiary (0.498) education proved to be significant determinants of HAZ, where the coefficients of maternal education were larger than those of fathers' education. Maternal primary (0.173) secondary (0.260) and tertiary (0.523) education were also significant determinants of WAZ. This finding concurs with the literature (Aslam and Kingdon, 2012, Güneş, 2015, Chen and Li, 2009). Furthermore, secondary (-0.091) and tertiary (-0.116) maternal education had a significantly negative effect on the perceived health status scores. Since a lower PHS score is favourable, we can deduce that the effect of maternal education on PHS is desirable. This result also implies that maternal education is a more significant determining factor of PHS than paternal education.

Maternal employment was a significant determinant of HAZ and WAZ. Conversely, there was little evidence to suggest a relationship between paternal employment and child anthropometric measurements. This supports previous research claiming that mothers and their characteristics may have a more direct impact on the health and growth of their children (Akter et al., 2015, Wamani et al., 2004). From the regression analysis, variables directly relating to the child, such as the age of the child, age-squared, gender, ethnicity and education all proved significant in the regressions of HAZ, WAZ and PHS. Children born at home were found to have significantly lower HAZs and WAZs than those born in hospitals. Having a medical professional overseeing childbirth may have led to improved child health as evidenced by the negative effect this variable had on PHS.

By using longitudinal data, this dissertation was able to compare changes in child health over the four waves of NIDS, in relation to the education level of fathers. This was done in order to uncover any possible causal relationship between paternal education and child health. Case and Ardington (2006) state that while many researchers have shown an association between parental characteristics and children's wellbeing, estimating a causal impact is difficult when using cross-sectional data. The authors believe that it may be more likely to draw causal inferences using longitudinal data, as they would be able to evaluate differences over time, such as wealth of households or a child's educational attainment before a parent's death. Semba et al. (2008) note that the cross-sectional design of their study limits the inferences of causality between parental education and child stunting.

There have, however, been some limitations encountered throughout this dissertation. Firstly, the effect of father's education on child health may have been affected by endogeneity bias. This occurs when the explanatory variable is correlated with the error term (Chou et al., 2010). Sources of endogeneity are: omitted variables, reverse-causality and measurement error (Antonakis et al., 2014). Endogeneity inhibits our ability to draw causal inference due to the bias it brings to statistical analysis. With regards to unobserved variables, certain variables which affect both paternal education and child health may have been omitted from the regression (Breierova and Duflo, 2004). This makes the coefficient of father's education biased in the regression equation, leading to our inability to state that a father's education directly impacts the health of his children. Reverse causality and omitted variables may cause education and child health to vary in the same direction (Chou et al., 2010, Ribar, 2004). Reverse causality arises because of a lack of knowledge surrounding the timing of specific events. Due to the fact that we are using four waves of NIDS, reverse causation regarding the timing of educational attainment of fathers is immaterial in this study.

Perhaps the most apparent drawback in this dissertation has been attrition in the datasets. During subsequent rounds of the NIDS surveys, respondents would either die, refuse to follow up or simply be lost by the surveyors. We see that only 53% of the sample of children in Wave 1 remained through to Wave 4. From the analysis of the percentage distributions of the sample of those who remain in the study for at least two consecutive waves compared to those who don't, we see that attrition in the dataset may be non-random. The attrition caused by the large number of people who left the study diminished our ability to draw causal inference regarding the effect of fathers' education on child health.

There are possible extensions to this dissertation's research. Including external family members, such as siblings, aunts, uncles and grandparents may be worthwhile. A break-down of the education of absent and deceased fathers may also be necessary. In sub-Saharan Africa, it is common for extended family members to look after children – not just biological parents. Secondly, Akin to the use of adoptive mothers in Chen and Li (2009), we could use data on single fathers in South Africa, and how their education links to child health. Just as this study on adoptive mothers eliminated biological links between mothers and their children, perhaps a study using single fathers may eliminate any possible maternal influence on child health. Another possible extension to this research would be to study the effect that the education of absent fathers may have on child health. Clark et al. (2015) posit that in South Africa, absent fathers still play a role in the lives of their children. Thus, their education may still have an effect on the health of their children, via their economic impact or otherwise. It may also be beneficial to include income of fathers as an independent variable in future studies.

There are also implications surrounding the topic of paternal absence and child health, which has been a well-documented and studied feature of sub-Saharan African countries. Previously, when analysing child health, this was not of particular concern due to the assertion that mothers played a more important role in the health of their children. Now while this may be true, it should not lead to the complete dismissal of paternal involvement in the child-raising process. By investigating further how fathers affect the health of their children, we may be able to address paternal absence in sub-Saharan Africa and could ultimately improve the physical and mental health of children in the developing world. In order to combat the high rate of paternal absence in South Africa, it is clear that education policies targeted towards young males are necessary. Furthermore, the education of young boys has shown, in this dissertation's results, to have a positive impact on child height-for-age and weight-for age. Language subjects are crucial for the development of young boys. Aside from cognitive development, adequate comprehension skills allow fathers to interpret medical advice, and converse with medical practitioners about the health of their children. It is also imperative that education on childbearing, contraception, the menstrual cycle and parenthood, is not limited to girls. On a policy level, government cannot force fathers to remain with their families. However, fathers can be incentivised to remain in the household by means of "paternal grants" – grants given to fathers who do not abandon their families. On a more practical level, government can spur community initiatives, spreading awareness of the benefits of paternal presence. Lastly, the government can launch social marketing campaigns, promoting the importance of fathers.

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Appendices

Table A.1: Sex and Race Breakdown of Children

	Wave 1		Wave 2		Wave 3		Wave 4	
Variable	N	%	N	%	N	%	N	%
Sex of children	9396		9810		11189		13047	
Male	4768	50,74	4928	50,23	5548	49,58	6462	49,53
Female	4628	49,26	4878	49,72	5641	50,42	6585	50,47
Missing		0,00	4	0,04		0,00		0,00
Race of children	9396		9810		11189		13047	
Don't know/missing	3	0,03	3	0,03		0,00	1	0,01
African	7789	82,90	8443	86,07	9614	85,92	11335	86,88
Coloured	1269	13,51	1184	12,07	1372	12,26	1544	11,83
Asian	95	1,01	62	0,63	62	0,55	73	0,56
White	240	2,55	118	1,20	141	1,26	94	0,72

Table A.2: Age of Children

	Wave 1		Wave 2		Wave 3		Wave 4	
	N	%	N	%	N	%	N	%
Total	9396		9810		11187		13047	
Don't Know	9	0,1	4	0,0	3	0,0	6	0,0
0	219	2,3	298	3,0	392	3,5	405	3,1
1	629	6,7	552	5,6	658	5,9	859	6,6
2	646	6,9	666	6,8	717	6,4	853	6,5
3	635	6,8	695	7,1	729	6,5	883	6,8
4	624	6,6	733	7,5	839	7,5	878	6,7
5	625	6,7	699	7,1	813	7,3	960	7,4
6	558	5,9	690	7,0	811	7,2	874	6,7
7	583	6,2	672	6,9	774	6,9	951	7,3
8	614	6,5	618	6,3	783	7,0	943	7,2
9	625	6,7	648	6,6	739	6,6	867	6,6
10	616	6,6	630	6,4	679	6,1	888	6,8
11	630	6,7	671	6,8	711	6,4	863	6,6
12	667	7,1	649	6,6	764	6,8	791	6,1
13	626	6,7	675	6,9	748	6,7	744	5,7
14	677	7,2	662	6,7	701	6,3	795	6,1
15	398	4,2	239	2,4	321	2,9	485	3,7
16	14	0,1	9	0,1	5	0,0	1	0,0
17	0	0,0	0	0,0	0	0,0	1	0,0
18	1	0,0	0	0,0	0	0,0	0	0,0

Table A.3: Grades of Children

	Wave 1		Wave 2		Wave 3		Wave 4	
	N	%	N	%	N	%	N	%
Total	5708		4950		7036		5466	
Don't know	58	1,0	71	1,4	7	0,1	33	0,6
Grade R/0	222	3,9	103	2,1	565	8,0	5	0,1
Grade 1	681	11,9	310	6,3	981	13,9	717	13,1
Grade 2	715	12,5	545	11,0	826	11,7	725	13,3
Grade 3	672	11,8	678	13,7	818	11,6	709	13,0
Grade 4	738	12,9	750	15,2	858	12,2	741	13,6
Grade 5	732	12,8	683	13,8	758	10,8	623	11,4
Grade 6	660	11,6	676	13,7	775	11,0	608	11,1
Grade 7	590	10,3	617	12,5	658	9,4	535	9,8
Grade 8	443	7,8	394	8,0	516	7,3	441	8,1
Grade 9	149	2,6	112	2,3	242	3,4	274	5,0
Grade 10	40	0,7	5	0,1	23	0,3	50	0,9
Grade 11	4	0,1	2	0,0	0	0,0	1	0,0
Other	3	0,1	4	0,1	7	0,1	4	0,1
No Schooling	1	0,0	0	0,0	2	0,0	0	0,0

Table A. 4: Random-Effects Estimates After Including Maternal BMI z-score

Variable	HAZ		WAZ		PHS	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Father's presence and education						
Present and No education (Base)						
Present and Primary	0.160*	0.084	0.079	0.079	0.052	0.056
Present and Secondary	0.216***	0.076	0.119*	0.071	-0.002	0.050
Present and Tertiary	0.374***	0.084	0.256***	0.077	0.032	0.055
Died	0.109	0.078	0.060	0.074	0.068	0.051
Absent	0.196***	0.075	0.111	0.070	0.065	0.049
Mother's presence and education						
Present and No education (Base)						
Present and Primary	0.105	0.077	0.097	0.071	0.033	0.051
Present and Secondary	0.263***	0.072	0.217***	0.066	-0.051	0.047
Present and Tertiary	0.510***	0.077	0.387***	0.070	-0.076	0.051
Died	0.128	0.081	0.154**	0.076	0.070	0.053
Absent	0.255***	0.074	0.258***	0.068	0.032	0.048
Father is employed	-0.002	0.023	0.004	0.020	-0.044***	0.015
Mother is employed	0.079***	0.023	0.056***	0.020	0.003	0.015
Mother's BMI z-score	-0.051***	0.008	0.580***	0.007	-0.020***	0.005
Age	0.035***	0.013	-0.099***	0.014	0.003	0.008
Age squared	-0.004***	0.001	0.010***	0.001	-0.001	0.001
Male child	-0.139***	0.022	-0.127***	0.018	0.027*	0.014
Race of child						
African (Base)						
Coloured	-0.123***	0.036	-0.104***	0.031	-0.130*	0.024
Asian/Indian	0.511***	0.172	0.297*	0.164	-0.256**	0.114
White	0.669***	0.108	0.368***	0.098	-0.038	0.071
Child's education level (grade)	-0.010***	0.001	-0.005***	0.001	-0.001	0.001
Place of birth						
Hospital (Base)						
Clinic	0.028	0.036	-0.002	0.030	0.031	0.024
Home	-0.317***	0.087	-0.212***	0.079	0.086	0.057
Medical personnel at birth						
No (Base)						
Yes	-0.108	0.088	-0.049	0.080	-0.118**	0.058

Don't know/Missing	-0.055	0.112	0.038	0.101	-0.352***	0.074
Rural dwelling	-0.025	0.024	-0.013	0.021	-0.078***	0.016
Constant	-1.074***	0.142	-0.509***	0.127	1.964***	0.094
N	14766		10178		14872	
R^2	0.0349		0.4461		0.0134	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A. 5: Random-Effects Estimates After Including Household Income

Variable	HAZ		WAZ		PHS	
	Coefficient	SE	Insufficient Data		Coefficient	SE
Father's presence and education						
Present and No education (Base)						
Present and Primary	0.150	0.147	-	-	0.196*	0.105
Present and Secondary	0.196	0.135	-	-	0.142	0.096
Present and Tertiary	0.324*	0.182	-	-	0.087	0.129
Died	0.186	0.128	-	-	0.181**	0.091
Absent	0.180	0.126	-	-	0.184**	0.090
Mother's presence and education						
Present and No education (Base)						
Present and Primary	0.172	0.107	-	-	0.109	0.077
Present and Secondary	0.227**	0.102	-	-	0.080	0.073
Present and Tertiary	0.145	0.105	-	-	0.128*	0.075
Died	0.264**	0.102	-	-	0.025	0.073
Absent	0.634***	0.137	-	-	0.034	0.096
Household Income						
Missing (Base)						
Much above average income	0.332*	0.182	-	-	0.060	0.125
Above average income	0.215	0.172	-	-	0.125	0.117
Average income	0.122	0.144	-	-	0.110	0.097
Below average income	0.114	0.146	-	-	0.135	0.098
Much below average income	0.060	0.147	-	-	0.161	0.100
Age	-0.166	0.136	-	-	-0.005	0.028
Age squared	0.001	0.006	-	-	-0.000	0.001
Male child	-0.057	0.042	-	-	-0.005	0.030
Race of child						
African (Base)						
Coloured	-0.140*	0.078	-	-	-0.210***	0.052
Asian/Indian	-0.026	0.333	-	-	-0.540**	0.227
White	1.035***	0.252	-	-	-0.303*	0.155
Child's education level (grade)	0.049***	0.012	-	-	-0.018**	0.008
Place of birth			-	-		
Hospital (Base)						
Clinic	-0.018	0.074	-	-	0.063	0.052
Home	-0.199	0.152	-	-	0.306***	0.101
Medical personnel at birth						
No (Base)						
Yes	-0.008	0.161	-	-	0.110	0.108
Don't know/Missing	-0.073	0.176	-	-	-0.055	0.120
Rural dwelling	-0.135***	0.049	-	-	-0.103***	0.034
Constant	0.088	0.793	-	-	1.559***	0.243
N	3448		-		3997	
R^2	0.059		-		0.0211	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$